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(54) SOLID POLYELECTROLYTE FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To eliminate insufficient humidification caused by temperature distribution generated in a battery module by forming a continuous channel of a cooling medium for cooling unit cells through inside of a fuel cell module and setting the water repellency of fuel electrodes of unit cells positioned closest to the channel entrance lower than the other unit cells.

SOLUTION: Fuel gas fed from a fuel gas feed pipe 63 and humidifying water flow in a gas fed channel formed of feed-side through-holes 34flow from the feed-side through-holes 34 of respective unit cells 2 into a collecting channeland distributed into a plurality of branch channelsflow into a plurality of grooves formed in the

respective unit cells 2and are fed for electrode reaction and humidification in the respective unit cells 2. In this caseentrances of the channel for humidifying water (cooling water) formed by the feed-side through holes 34 of a plurality of the unit cells 2namely unit cells 2a2a positioned in both ends of a fuel cell module 1 have the water repellency set lower than the other unit cells 2.

CLAIMS

[Claim(s)]

[Claim 1]Laminate two or more unit cells (2)it is constituted by fuel cell module (1) of oneand each unit cell (2)Make solid polyelectrolyte membrane (22) intervene between a fuel electrode (24) and an oxidizing agent pole (23)and it is constitutedand to a fuel electrode (24). In a solid polyelectrolyte type fuel cell which fuel gas is suppliedand oxidant gas is supplied to an oxidizing agent pole (23)and can take out to the exterior electric power which each unit cell (2) generatesA channel of a cooling medium for cooling a unit cell (2) is penetrated and formed in an inside of a fuel cell module (1)A solid polyelectrolyte type fuel cellwherein at least one unit cell (2a) nearest to an entrance of this channel is set up in the water repellence of a fuel electrode (24) lower than other unit cells (2).

[Claim 2]In a fuel electrode (24)a catalyst bed is formed in a field in contact with solid polyelectrolyte membrane (22)and. The solid polyelectrolyte type fuel cell according to claim 1 with which a gas diffusion layer is formed in a field of the opposite handand said at least one unit cell (2a) is set up in the water repellence of a gas diffusion layer of a fuel electrode (24) lower than other unit cells (2).

[Claim 3]The solid polyelectrolyte type fuel cell according to claim 2 currently formed few from other unit cells (2) in an addition of a fluoro-resin [as opposed to a gas diffusion layer of a fuel electrode (24) in said at least one unit cell (2a)].

[Claim 4]The solid polyelectrolyte type fuel cell according to claim 3 whose addition of a fluoro-resin to a gas diffusion layer of a fuel electrode (24) which constitutes said at least one unit cell (2a) is 0.8 or less wt. ratio to the addition of

other unit cells (2).

[Claim 5]The solid polyelectrolyte type fuel cell according to claim 3 or 4 whose addition of a fluoro-resin to a gas diffusion layer of a fuel electrode (24) which constitutes said at least one unit cell (2a) is five or more weight sections.

[Claim 6]In a fuel electrode (24)a catalyst bed is formed in a field in contact with solid polyelectrolyte membrane (22)and. The solid polyelectrolyte type fuel cell according to claim 1 with which a gas diffusion layer is formed in a field of the opposite handand said at least one unit cell (2a) is set up in the water repellence of a catalyst bed of a fuel electrode (24) lower than other unit cells (2).

[Claim 7]The solid polyelectrolyte type fuel cell according to claim 6 currently formed few from other unit cells (2) in an addition of a fluoro-resin [as opposed to a catalyst bed of a fuel electrode (24) in said at least one unit cell (2a)].

[Claim 8]The solid polyelectrolyte type fuel cell according to claim 7 whose addition of a fluoro-resin to a catalyst bed of a fuel electrode (24) which constitutes said at least one unit cell (2a) is 0.8 or less wt. ratio to the addition of other unit cells (2).

[Claim 9]The solid polyelectrolyte type fuel cell according to claim 7 or 8 whose addition of a fluoro-resin to a catalyst bed of a fuel electrode (24) which constitutes said at least one unit cell (2a) is more than the amount part of duplexs.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention makes solid polyelectrolyte membrane intervene between a fuel electrode and an oxidizing agent polesupplies fuel gas to a fuel electrodeand supplies oxidant gas to an oxidizing agent poleand relates to the solid polyelectrolyte type fuel cell made to generate electric power.

[0002]

[Description of the Prior Art]In recent yearsan energy conversion efficiency is highthe fuel cell which does not generate a toxic substance for ** by a power generation reaction attracts attentionand the solid polyelectrolyte type fuel cell which operates at a low temperature of 100 ** or less is known as one of the fuel cells of these.

[0003]Drawing 16 expresses the power generation principle of a solid polyelectrolyte type fuel celland arrange a fuel electrode (55) and an oxidizing agent pole (56) on both sides of the solid polyelectrolyte membrane (54) of ion conductivityand. A combustion chamber (57) and an oxidizing agent chamber (58) are arranged on the both sidesa cell (50) is formedand the fuel electrode (55) and the oxidizing agent pole (56) are mutually connected via the external circuit (59).

[0004]It is decomposed into hydrogen ion H^+ and electronic e^- by hydrogen H_2 contained in the fuel gas supplied to the combustion chamber (57) in a fuel electrode (55)and hydrogen ion H^+While moving the inside of solid polyelectrolyte membrane (54) toward an oxidizing agent pole (56) in the water molecule in this film (54)and the form where it hydratedelectronic e^- flows through an external circuit (59) toward an oxidizing agent pole (56). In an oxidizing agent pole (56)oxygen O_2 contained in the oxidant gas supplied to the oxidizing agent chamber (58) reacts to hydrogen ion H^+ and electronic e^- which were supplied from the fuel electrode (55)and water H_2O is generated. Thusas the whole cellwater is generated from hydrogen and oxygen and electromotive force occurs.

[0005]Since the electromotive force of one cell (50) is lowtwo or more cells (50) of each other are connected in seriesand a solid polyelectrolyte type fuel cell is constituted. For examplethe solid polyelectrolyte type fuel cell (5) shown in drawing 13Laminate the unit cell (50) of two or more monotonous typesconstitute the battery module of oneand supply fuel gassuch as hydrogen gasto these unit cells (50)and. It is possible to take out to the exterior the electric power which supplies oxidant gassuch as airand two or more unit cells (50) by which the series connection was carried out generate.

[0006]In this solid polyelectrolyte type fuel cell (5)two or more fuel gas supply grooves (graphic display abbreviation) extended in the perpendicular direction and two or more oxidant gas supply grooves (53) extended horizontally are established by each unit cell (50). To the unit cell (50) arranged at one end. A fuel gas inlet hole (51a) is formedand to the unit cell (50) arranged at the end of another side. A fuel gas outlet hole (52a) is formedand the breakthrough for fuel gas supply (51) and the breakthrough for fuel gas discharge (52) are established by two or more of other unit cells (50) except the unit cell of these both endsrespectively. And by piling up two or more unit cells (50) of each othera fuel gas inlet hole (51a) and two or more breakthroughs for fuel gas supply (51) are mutually open for free passageand one fuel gas supply route is formedand. Two or more breakthroughs for fuel gas discharge (52) and fuel gas outlet holes (52a) are mutually open for free passageand one fuel gas exhaust passage is formed.
[0007]The solid polyelectrolyte type fuel cell (5) covered the side which two or more above-mentioned oxidant gas supply grooves (53) exposedand is provided with the oxidant gas supply manifold (6) for supplying oxidant gas to these oxidant gas supply grooves (53). For example turn caudadand an opening is carried outand the opening of the oxidant gas supply manifold (6) is carried out towards said side.
The air taken in from the downward opening is sent into two or more oxidant gas supply grooves (53).

[0008]In the above-mentioned solid polyelectrolyte type fuel cell (5)fuel gasAs the arrow of a solid line shows in a figurea fuel gas inlet hole (51a) is suppliedand it is distributed to two or more fuel gas supply grooves formed in each unit cell (50) through said fuel gas supply routeand a power generation reaction is presented in the process in which it flows through each fuel gas supply groove downward. On the other handas the arrow of a dashed line shows in a figureoxidant gas is taken in from the opening of the lower part of an oxidant gas supply manifold (6)and is sent into an oxidant gas supply groove (53) through the opening of the

sideand a power generation reaction is presented with it in the process in which it flows through each oxidant gas supply groove (53).

[0009]Drawing 14 and drawing 15 express the concrete structure of the unit cell (10) constituted by the layered product of the plate-like member of two or more sheets. Cover one surface of solid polyelectrolyte membrane (11)and arrange an oxidizing agent pole (12)and. The surface of this oxidizing agent pole (12) was coveredand the oxidizing agent pole side conductive plates (14) in which two or more oxidant gas supply grooves (19) were cut have been arrangedand also the conductive gas separator (16) is arranged on the outside of the oxidizing agent pole side conductive plates (14). Cover the surface of another side of solid polyelectrolyte membrane (11)and a fuel electrode (13) is arrangedand the surface of this fuel electrode (13) was covered and the fuel electrode side conductive plates (17) in which two or more fuel gas supply grooves (18) were cut are arranged.

[0010]In the above-mentioned unit cell (10)oxidant gas (33) is sent into the oxidant gas supply groove (19) of the oxidizing agent pole side conductive plates (14)and fuel gas (31) is sent into the fuel gas supply groove (18) of the fuel electrode side conductive plates (17). In a fuel electrode (13)the hydrogen contained in the fuel gas (31) which flows through a fuel gas supply groove (18) is decomposed into a hydrogen ion and an electron by thisand a hydrogen ion moves the inside of solid polyelectrolyte membrane (11) toward an oxidizing agent pole (12) by it in the form of a hydrogen ion. On the other handin an oxidizing agent pole (12)the oxygen contained in the oxidant gas (33) which flows through an oxidant gas supply groove (19) reacts to the hydrogen ion and electron which were supplied from the fuel electrode (13)and water is generated.

[0011]By the wayalthough the typical solid polyelectrolyte membrane adopted as a solid polyelectrolyte type'fuel cell is cation exchange membranesuch as perfluorocarbon sulfonic acidIn order to make a hydrogen ion penetratethe moisture for carrying out moistness of the solid polyelectrolyte membrane and the moisture for hydrating to the hydrogen ion called move water are required.

[0012]Since moisture required for the moistness of solid polyelectrolyte membrane is in the tendency which run short only with the moisture (produced water) produced by an electrode reactionthe insufficiency is provided by the supply from the outside. The method most often performed is the method of humidifying hydrogen which is fuel gas.
The supplied moisture penetrates the gas diffusion layer of a fuel electrodeand is conveyed to the surface of a catalyst bed or solid polyelectrolyte membrane.

[0013]Most generally as a gas diffusion layerthe conductive porous body made from carbon represented by carbon paper is used. Since the pore diameters of a conductive porous body are a number - 10 microns of numbers aboutwater demonstrates the permeability in which the state of a steam is higher than the state of a liquid. Thereforeas a form of watera steam is the most desirable. Howeverit is necessary to give a water-repellent finish with a fluoro-resin etc. so that water remaining may not occur in the stoma of carbon paper. As for a fluoro-resinalthough adding a small quantity also reveals water repellencesince water repellence tends to fall during operation of a fuel cellit is advantageous to add the fluoro-resin of as much quantity as possible from a durable viewpoint.
[0014]Although the solid polyelectrolyte type fuel cell needs to maintain the temperature at 130 ** or less which is the optimal operating temperature limitsince a unit cell generates heat with power generationmaintaining a unit cell at an optimum operation temperature requirement is performed by supplying the water for cooling to a battery module. The system which supplies moisture to a fuel cell is classified into an external humidification system and an internal humidification system. In an external humidification systemmoisture required for the moistness of solid polyelectrolyte membrane is evaporated in the exterior of a celland is supplied in a cell as a steam. The cooling water for controlling battery temperature is supplied to a fuel cell module in the state of a liquid apart from humidifying water. For examplethe temperature of a unit cell is controlled by making a cooling plate placed between two or more places of a battery

moduleand supplying cooling water to this cooling plate. On the other handin an internal humidification systemthe inside of modular is supplied in the state of a liquidthe part is evaporated by modular heatmoisture (humidifying water) required for the moistness and the electrode reaction of solid polyelectrolyte membrane serves as a steamand humidification of gas is presented with it. The water supplied to the inside of modular will be used also as cooling water for controlling battery temperature. That isin an internal humidification systemhumidifying water will play two roles of cooling of humidification of gasand a cell.

[0015]Since humidifying water is supplied in a cell with a liquidit is not necessary to install the equipment for heating humidifying water out of a celland an inexpensive and compact system can consist of fuel cells of an internal humidification system. Although the humidifying water which it was in use having made it circulate and having used as for humidifying waterand was discharged by passing a module contains a steam so muchit is cooled out of a moduleand it returns to a liquidand is again supplied to a module by a liquid pump.

[0016]

[Problem to be solved by the invention]Howeverin order that the water for cooling supplied to the battery module regardless of the humidification system may carry out a rise in heat gradually by heat exchange in the process in which the inside of a battery module is passedin a fuel cellFor examplein the fuel cell which established the entrance of the water for cooling in the both ends of the battery modulethe cell near [this] the entrancei.e.the cell located in the both ends of a cell laminating directionserves as the lowest temperaturethe cell of a center section serves as the highest temperatureand the **** temperature distribution shown in drawing 9 will arise. Especially the quantity of heat from which the cell located in the end of a lamination direction is taken in the fuel cell of an internal humidification system since some humidifying water evaporates within a cell is larger than the case of an external humidification systemand tends to produce temperature distribution. In the fuel cell of an external humidification systemthe unit cell of temperature which adjoins a cooling plate is the lowestandas for a unit

cell far from a cooling platetemperature becomes high.

[0017]In a battery module which such temperature distribution producedsince a steam partial pressure falls and a water vapor content decreases in a cell to which temperature fellhumidifying becomes insufficient and degradation is caused. If degradation occurs in some cells in a modulethis influence will attain to other cells and will cause sag of the whole module. For examplein the state where a fuel cell module is operated with rated apparent power (a product of voltage and current is constant)when sag occurs in some cellsan increase in current will occur in order to compensate this sagandas a resultdegradation of the whole module will be brought forward.

[0018]By making into a heating resistor a collecting electrode plate which attaches a heating resistor to both ends of a module in which temperature becomes the lowestor is arranged to modular both endsin order to solve such a problemA fuel cell which controlled a temperature fall of module both ends is proposed (JPH8-167424A). Howeverthere was a problem from which an equipment configuration not only becomes complicated by equipment of a heating resistorbut sufficient calorific value is not obtained depending on an operating conditionand sufficient temperature distribution mitigation effect is not acquired when there is little output current of a cell.

[0019]Thenthe purpose of this invention is to provide a solid polyelectrolyte type fuel cell of simple composition of that a problem resulting from temperature distribution generated in a battery module that humidification is insufficient can be solved without equipping special equipmentsuch as a heating resistor.

[0020]

[Means for Solving the Problem]In a solid polyelectrolyte type fuel cell concerning this inventionLaminate two or more unit cells (2)it is constituted by fuel cell module (1) of oneand inside a fuel cell module (1)A channel of a cooling medium for cooling a unit cell (2) penetratesand is formedand at least one unit cell (2a) nearest to an entrance of this channel is set up in the water repellence of a fuel electrode (24) lower than other unit cells (2). In a fuel cell of an internal

humidification systemsince humidifying water serves as a cooling mediumthe water repellence of a unit cell (2a) nearest to an entrance of a supply route of humidifying water is set up lower than other unit cells (2). In a fuel cell of an external humidification system which forms a channel of a cooling medium (cooling water) with a cooling plate etc.and cools a unit cellthe water repellence of a unit cell (2a) nearest to an entrance of a channel of cooling mediasuch as a cooling plateis set up lower than other unit cells (2).

[0021]Although temperature becomes the lowest by a unit cell nearest to an entrance of a cooling medium (2a)for examplea unit cell arranged at a modular end(2a) and quantity of a steam by which it is generated decreases in a solid polyelectrolyte type fuel cell of above-mentioned this inventionSince the water repellence of a fuel electrode (24) which constitutes this unit cell (2a) is set up lower than other unit cells (2)a steam by which it was generated in this unit cell (2a) moves smoothly in inside of a fuel electrode (24)without crawling violently. As a resultsufficient humidification is performed also in this unit cell (2a). Since there is little quantity of a steam by which it is generated in this unit cell (2a)though the water repellence of a fuel electrode (24) is reducedthere is no possibility that water remaining may arise in a stoma of a gas diffusion layer.

[0022]In specific constitutionsaid at least one unit cell (2a) is set up in the water repellence of a gas diffusion layer of a fuel electrode (24) lower than other unit cells (2). In this unit cell (2a)a steam by which it was generated will move easily in inside of a gas diffusion layerand will be supplied to a catalyst bed by this.

[0023]Specifically in an addition of a fluoro-resin to a gas diffusion layer of a fuel electrode (24)said at least one unit cell (2a) is formed few from other unit cells (2). By thisthe water repellence of a gas diffusion layer of a fuel electrode (24) which constitutes said at least one unit cell (2a) can be set up lower than the water repellence of other unit cells (2). As a fluoro-resinpolytetrafluoroethylenea tetrafluoroethylene hexafluoropropylene copolymerA tetrafluoroethylene ethylene polymertetrafluoroethylene hexafluoro alkyl vinyl ether copolymersor these mixtures are employable.

[0024]Specificallyan addition of a fluoro-resin to a gas diffusion layer of a fuel electrode (24) which constitutes said at least one unit cell (2a) is set as 0.8 or less wt. ratio to the addition of other unit cells (2). Movement of a steam in a gas diffusion layer of a fuel electrode (24) which constitutes this unit cell (2a) becomes smooth enoughand the high humidification effect is acquired by this.
[0025]An addition of a fluoro-resin to a gas diffusion layer of a fuel electrode (24) which constitutes said at least one unit cell (2a) is set as five or more weight sections. By thisthe water repellence of a gas diffusion layer of a fuel electrode (24) which constitutes this unit cell (2a) can be maintained to necessary minimumand water remaining of a stoma of a gas diffusion layer can be prevented.
[0026]In other specific constitutionsaid at least one unit cell (2a) is set up in the water repellence of a catalyst bed of a fuel electrode (24) lower than other unit cells (2). In this unit cell (2a)a steam by which it was generated will move easily in inside of a catalyst bedand will be supplied to solid polyelectrolyte membrane by this.
[0027]Specifically in an addition of a fluoro-resin to a catalyst bed of a fuel electrode (24)said at least one unit cell (2a) is formed few from other unit cells (2). By thisthe water repellence of a catalyst bed of a fuel electrode (24) which constitutes said at least one unit cell (2a) can be set up lower than the water repellence of other unit cells (2). As a fluoro-resinpolytetrafluoroethylenea tetrafluoroethylene hexafluoropropylene copolymerA tetrafluoroethylene ethylene polymertetrafluoroethylene hexafluoro alkyl vinyl ether copolymersor these mixtures are employable.
[0028]Specificallyan addition of a fluoro-resin to a catalyst bed of a fuel electrode (24) which constitutes said at least one unit cell (2a) is set as 0.8 or less wt. ratio to the addition of other unit cells (2). Movement of a steam in a catalyst bed of a fuel electrode (24) which constitutes this unit cell (2a) becomes smooth enoughand the high humidification effect is acquired by this.
[0029]An addition of a fluoro-resin to a catalyst bed of a fuel electrode (24) which

constitutes said at least one unit cell (2a) is set up more than the amount part of duplexs. Water can be prevented from maintaining the water repellence of a catalyst bed of a fuel electrode (24) which constitutes this unit cell (2a) to necessary minimumand stagnating in a catalyst bed by this. Thereforea flow of gas is not checked.

[0030]As for this inventionin a fuel cell of an internal humidification systema high effect is acquired especially. Solid polyelectrolyte membrane (22) which constitutes a unit cell (2) A perfluorocarbon-sulfonic-acid systemSince sufficient moistness is required in order for this poly membrane to show ionic conduction nature when formed of which poly membrane of a polystyrene divinylbenzene sulfonic acid system and a phenolformaldehyde systemthis invention is effective.

[0031]

[Effect of the Invention]According to the solid polyelectrolyte type fuel cell concerning this inventionwithout equipping special equipmentsuch as a heating resistorwith the simple composition which adjusts the water repellence of a unit cellthe whole module can be covered and sufficient humidification can be performed.

[0032]

[Mode for carrying out the invention]Hereafterthis invention is concretely explained over Drawings about the form carried out to the solid polyelectrolyte type fuel cell of the internal humidification type. The solid polyelectrolyte type fuel cell concerning this inventionAs shown in drawing 1laminate two or more unit cells (2)pinch this layered product from both sides with the current collection plate (7) and (7) of a coupleand the fastening plate (6) and (6) is further arranged on the both sidesThe fuel cell module (1) of one is constituted by binding both the fastening plates (6) and (6) tight with two or more fastening bolts (61) and a conclusion nut (62).

[0033]The two fuel gas supply pipes (63) and (63) for supplying fuel gas (hydrogen gas) and humidifying water to an upper bed part to each unit cell (2) are connected with each fastening plate (6)and in a lower end part. The two

unconverted-gas exhaust pipes (64) and (64) for discharging the unconverted gas which passed each unit cell (2) are connected. The electrode terminal (71) and (71) of the couple for taking out the generating electric power of a fuel cell module (1) outside protrudes on the current collection plate (7) and (7) of a couple. The manifold (graphic display abbreviation) for supplying the air which is oxidant gas is arranged at the back side of the fuel cell module (1) shown in drawing 1.

[0034]As each unit cell (2) is shown in drawing 2have the structure which pinched the cell unit (21) from both sides with the conductive plates (3) and (3)and an insulation sheet (25) intervenes between both conductive plates (3) and (3)The electric insulation and the gas seal between both conductive plates (3) and (3) are given.

[0035]As conductive plates (3) are formed from conductive materialssuch as carbon and metaland it is shown in drawing 2 and drawing 4 - drawing 7in an upper bed part. The supply side breakthrough (34) and (34) of the right-and-left couple connected with said fuel gas supply pipe (63) and (63) is establishedand the discharge side breakthrough (35) and (35) of the right-and-left couple connected with said unconverted-gas exhaust pipe (64) and (64) is established by the lower end part. The supply side breakthrough (34) and (34) of a right-and-left couple is mutually connected via the set channel (36) horizontally extended in the inside of conductive plates (3)and the discharge side breakthrough (35) and (35) of the right-and-left couple is mutually connected via the set channel (37) horizontally extended in the inside of conductive plates (3).

[0036]The crevice (31) where a fuel electrode (24) engages with an opposed face with the fuel electrode (24) of a cell unit (21) is formed in conductive plates (3)and at the pars basilaris ossis occipitalis of this crevice (31). Two or more slots (32) for passing fuel gas (hydrogen gas) perpendicularlyThe groove is cut in parallel mutuallythe both ends of each slot (32) have led to the branching channel (38) and (39) extended up and down in the inside of conductive plates (3)respectivelyand these branching channels (38) and (39) have led to said set

channel (36) and (37). [0037]On the other handto an opposed face with the oxidizing agent pole (23) of a cell unit (21). The crevice (41) where an oxidizing agent pole (23) is engaged is formedand at the pars basilaris ossis occipitalis of this crevice (41). Two or more slots (42) for passing oxidant gas (air) horizontallyThe groove is cut in parallel mutuallythe both ends of each slot (42) are connected with the channel (43) and (43) extended right and left in the inside of conductive plates (3)respectivelyand the opening of these channels (43) is carried out in respect of the both ends of conductive plates (3). The crevice (31) and (41) is surrounded in both sides of conductive plates (3)respectivelyand the slot (33) and (40) for putting an O ring (28) is cut in them.

[0038]An oxidizing agent pole (23) and a fuel electrode (24) are arranged to both sides of solid polyelectrolyte membrane (22)and a cell unit (21) is constitutedas shown in drawing 3. Heresolid polyelectrolyte membrane (22) is formed in the bigger outside dimension than an oxidizing agent pole (23) and a fuel electrode (24). An oxidizing agent pole (23) and a fuel electrode (24) form the catalyst bed which has electrode catalysis on an electrode substraterespectivelyand are constituted. It also exhibits the function of current collection at the same time an electrode substrate adds water repellent materialsuch as a fluoro-resinto conductive porous materialssuch as carbon paperis producedgenerally exhibits the function as a gas diffusion layer and performs supply and discharge of fuel gasand oxidant gas and a steam. After mixing the catalyst and water repellent materialsuch as a fluoro-resincontaining platinum particles generallymixing a solvent to this and considering it as paste state or the shape of inka catalyst bed applies this to one side of solid polyelectrolyte membrane and the electrode substrate which should counterand is formed.

[0039]An insulation sheet (25) is formed from insulating materialssuch as a fluoro-resin and rubberand has the outside dimension same in said conductive plates (3) and abbreviationand it has an opening (26) into which the solid polyelectrolyte membrane (22) of a cell unit (21) fits. Four breakthrough (27) - (27) corresponding to the supply side breakthrough (34) of said conductive plates

(3)(34)and the discharge side breakthrough (35) and (35) is established by the upper bed part and lower end part of the insulation sheet (25).

[0040]A current collection plate (7) is formed from conductive materialssuch as carbon and metaland as shown in drawing 8four breakthrough (72) - (72) corresponding to the supply side breakthrough (34) of said conductive plates (3)(34)and the discharge side breakthrough (35) and (35) is established by the upper bed part and the lower end part. The electrode terminal (71) and (71) of said couple protrudes on the end face of a current collection plate (7).

[0041]Thereforeby putting a cell unit (21) and an insulation sheet (25) between the conductive plates (3) of two sheetsand (3)as shown in drawing 2The oxidizing agent pole (23) of a cell unit (21) engages with the crevice (41) of left-hand side conductive plates (3)and. The fuel electrode (24) of a cell unit (21) will engage with the crevice (31) of right-hand side conductive plates (3)and the periphery of solid polyelectrolyte membrane (22) will be further pinched by the periphery of conductive plates (3) on either side and (3) from both sides via an O ring (28) and (28). It will be placed between the junctions of conductive plates (3) on either side and (3) by the insulation sheet (25). As a resultelectric insulation between conductive plates (3) on either side and (3) is performed at the same time the seal of the fuel gas which flows through the slot (32) of right-hand side conductive plates (3)and the oxidant gas which flows through the slot (42) of left-hand side conductive plates (3) is given. Thusone unit cell (2) comprises combination of a cell unit (21)an insulation sheet (25)and conductive plates (3).

[0042]Like drawing 1laminate two or more unit cells (2)arrange the current collection plate (7) and (7) on the both sidesand the fastening plate (6) and (6) is further arranged on the both sidesThe fuel cell module (1) of one is assembled by binding both the fastening plates (6) and (6) tight with two or more fastening bolts (61) and a conclusion nut (62). Thusin the assembled fuel cell module (1)One gas supplying path which the supply side breakthrough (34) of two or more fuel cell modules (1) is connected mutuallyand is connected with the fuel gas supply pipe (63) and (63) is formedand. The discharge side breakthrough

(35) of two or more fuel cell modules (1) is connected mutuallyand one gas exhaust passage connected with the unconverted-gas exhaust pipe (64) and (64) is formed.

[0043]Thereforewhen fuel gas and humidifying water are supplied from a fuel gas supply pipe (63) and (63)this fuel gas and humidifying waterIt flows into a set channel (36) from the supply side breakthrough (34) of each unit cell (2)flowing through the gas supplying path formed of a supply side breakthrough (34)It will be distributed to two or more more branching channels (38)and will flow into two or more slots (32) currently formed in each unit cell (2)and an electrode reaction and humidification will be presented by each unit cell (2). Unreacted fuel gas and water will flow into a set channel (37) through two or more branching channels (39)and also will be discharged from the unconverted-gas exhaust pipe (64) and (64) through the gas exhaust passage formed of the discharge side breakthrough (35).

[0044]The entrance of the channel of the humidifying water (cooling water) formed in the above-mentioned fuel cell module (1) of the supply side breakthrough (34) of two or more unit cells (2)That isthe unit cell (2a) (2a) located in the both ends of a fuel cell module (1) is set up in the water repellence of a fuel electrode (24) lower than other unit cells (2). The water repellence of a fuel electrode (24) is adjusted by changing the quantity of the fluoro-resin which should specifically be added to the catalyst bed on the electrode substrate (gas diffusion layer) which constitutes a fuel electrode (24)and/or an electrode substrate by the position of a unit cell (2).

[0045]

[Working example]The fuel cell module (1) of above-mentioned this invention is actually producedand the result compared with the conventional fuel cell module is explained.

[0046]The cell unit used for the fuel cell module of working example 1 this example was produced as follows.By heat-treating by making the carbon paper of area ^{2} of 100 cm impregnate commercial fluorocarbon-resin-dispersion liquid

(polytetrafluoroethylene (PTFE) dispersed solution)carbon paper weight: -- the electrode substrate of fluoro-resin weight:50 is produced to 100 -- bothThe alcohol solution of the end of carbon powder platinum particles were supportedand perfluorocarbon sulfonic acidAnd after preparing the slurry which contains the fluoro-resin of 25 weight sections to said end of carbon powderthe oxidizing agent pole (23) and the fuel electrode (24) were produced by applying said slurry on said electrode substrate so that a platinum holding amount may serve as about 1 mg/cm^{2}and drying this. These oxidizing agent poles (23) and fuel electrodes (24) were joined to both sides of the solid polyelectrolyte membrane (22) which consists of a perfluorocarbon-sulfonic-acid system poly membrane by methodssuch as a hotpressand the cell unit (21) was produced.
[0047]Howeverabout a cell unit (21) used for a unit cell (2a) located in a module endquantity of a fluoro-resin added to carbon paper in production of a fuel electrode (24) was made into 20 weight sections. By thisan addition of a fluoro-resin in a diffusion zone of a fuel electrode (24) used for this unit cell (2a) serves as a ratio of 0.4 to a fluoro-resin addition in a diffusion zone of a fuel electrode (24) used for other unit cells (2).
[0048]Thusthe number of laminations of a produced unit cell (2) was set to 30and a fuel cell module of working example 1 was assembled.
[0049]All the unit cells of comparative example 1 fuel cell module assembled a fuel cell module constituted by the same unit cell as a unit cell (2) of a center section of above-mentioned working example 1and considered it as the comparative example 1.
[0050]Humidifying water and hydrogen of 300 cc/min were supplied to the fuel gas supply pipe (63) and (63) of each fuel cell module for a fuel cell module of performance comparison working example 1 and the comparative example 1and rated operation of module output 0.5kw was performed.As for quantity of humidifying water which should be suppliedit is desirable to determine suitably in consideration of conditionssuch as cell constitution and output current.
[0051]Drawing 10 expresses aging of module voltages in working example 1 and

the comparative example 1. Like a graphic displaya fall of voltage with the passage of time is small in working example 1 compared with the comparative example 1. A moisture content which steam pressure of water becomes low in the comparative example 1 since temperature of a unit cell of both ends is lowthis penetrates a gas extension layer of a fuel electrodeand reaches a catalyst bed decreasesand water required for power generation is insufficient for itIt is because the water repellence of a gas diffusion layer of a fuel electrode which constitutes a unit cell of a module end from working example 1 is suppressed to the reactivity of this unit cell fallingso quantity of moisture which reaches a catalyst bed increases and a fall of the reactivity of this unit cell is controlled.

[0052]Working example 2 this example examined the effective range about a water-repellent difference which should be given to a unit cell of a module end.Although an addition of a fluoro-resin to a gas diffusion layer of a fuel electrode which constitutes a cell of a module end is made into a ratio of 0.4 to the addition of other cells in working example 1In this examplethe amount of fluoro-resins added to a gas diffusion layer of a fuel electrode about a cell of a module endrespectivelyFour kinds of fuel cell modules (working example a-d) made into the amount part of duplexs (ratio 0.04)five weight sections (ratio 0.1)40 weight sections (ratio 0.8)and 45 weight sections (ratio 0.9) were produced.

[0053]Drawing 11 expresses change of module voltages when the same operation as working example 1 is performed. In working example b (ratio 0.1)working example c (ratio 0.8)and working example 1 (ratio 0.4)a fall of module voltages with the passage of time is reduced notablyand a big effect is acquired so that clearly from this graph.

[0054]Howeverin working example d (ratio 0.9)water repellence became excessiveand since the moisture content which can reach the catalyst bed of a fuel electrode decreasedthe depressor effect of the reactant fall became comparatively small. Thereforeit can be said that it is preferred to set it as 0.8 or less ratio to the addition of other cells as for the fluoro-resin addition to the gas

diffusion layer of the fuel electrode which constitutes the cell of a module end.

[0055]In working example a (ratio 0.04)since there was little absolute magnitude of the added fluoro-resin as the amount part of duplexswater repellence became [too little]and since water remaining occurred in the stoma of a gas diffusion layer and the gas diffusion nature of a fuel electrode fell by thisthe depressor effect of the reactant fall became comparatively small. Thereforeit can be said that five or more weight sections are preferred as absolute magnitude as for the fluoro-resin addition to the gas diffusion layer of the fuel electrode which constitutes the cell of a module end.

[0056]By working example 3 this exampleit replaced with performing water-repellent adjustment by a diffusion zoneand the effect at the time of carrying out by a catalyst bed was examined.The quantity of the fluoro-resin to the catalyst bed of the fuel electrode which constitutes the unit cell (2a) of the module end produced in working example 1 from this exampleThe fuel cell module (working example efand ghi) whose number of lamination cells is five kinds of 30 was produced like working example 1 except having considered it as one weight sectionthe amount part of duplexsten weight sections20 weight sectionsand 23 weight sections to the end of carbon powder.

[0057]In these fuel cell modulesthe fluoro-resin addition to the catalyst bed of the fuel electrode which constitutes the unit cell (2a) of a module end has a ratio of 0.040.080.40.8and 0.92 to the addition of other unit cellsrespectively (refer to Table 1).

[0058]

[Table 1]

[0059]Drawing 12 expresses change of module voltages when the same operation as working example 1 is performed. In working example f (ratio 0.08)working example g (ratio 0.4)and working example h (ratio 0.8)the fall of module voltages with the passage of time is reduced notablyand the big effect is

acquired so that clearly from this graph.

[0060]Howeverin working example i (ratio 0.92)water repellence became excessiveand since the moisture content which can reach the catalyst bed of a fuel electrode decreasedthe depressor effect of the reactant fall became comparatively small. Thereforeit can be said that it is preferred to set it as 0.8 or less ratio to the addition of other cells as for the fluoro-resin addition to the catalyst bed of the fuel electrode which constitutes the cell of a module end.

[0061]In working example e (ratio 0.04)since there was little absolute magnitude of the added fluoro-resin as one weight sectionwater repellence became [too little]and in order for water to stagnate in a catalyst bed and to check the flow of gas by thisthe depressor effect of the reactant fall became comparatively small. Thereforethe fluoro-resin addition to the catalyst bed of the fuel electrode which constitutes the cell of a module end can be said to be preferred [more than the amount part of duplexs] as absolute magnitude.

[0062]The solid polyelectrolyte type fuel cell concerning this inventionThe solid polyelectrolyte membrane with great influence of a humidified state to battery capacityfor examplea perfluorocarbon-sulfonic-acid systemEspecially in the fuel cell using solid polyelectrolyte membranesuch as a polystyrene divinyl BENZE sulfonic acid system and a phenolformaldehyde systemit is effectiveand modular temperature distribution is effective in the fuel cell of the internal humidification system which tends to become large.

[0063]In above-mentioned working example 3in order to control the water repellence of a catalyst bedthe addition of a fluoro-resin is adjustedbut the method of controlling water repellence by the character in the end of carbon powder which is carrying out not only this but the catalyst at the time of ** is employable. In this casesince water repellence changes also with those form and surface statessurface areaa degree of graphitizationetc. are a cell of a module endand a cell of a module center sectionand may give a difference to water repellence the end of carbon powder by using the thing of character which is different in the end of the carbon powder used for a catalyst bedrespectively.

[0064]In above-mentioned working example 1-3although PTFE is used as a fluoro-resinIt is possible not only this but to produce similarly using a tetrafluoroethylene hexafluoropropylene copolymer (FEP)a tetrafluoroethylene ethylene polymer (ETFE)a tetrafluoroethylene hexafluoro alkyl vinyl ether copolymer (PFA)etc.

[0065]It is preferred that the unit cell (2a) of the module end which should adjust water repellence can adjust water repellence about two or more unit cells near the module end not only one butand sets up the number according to the conditions of the number of laminations of a cell or others. In this caseit is also possible to give distribution to the water repellence of two or more unit cells according to the temperature distribution shownfor example in drawing 9.

[0066]It is also possible to carry out to the fuel cell of the internal humidification system which this invention forms a circulating-water-flow way with a cooling plate etc.and cools a unit cellor an external humidification systemIn this casethe water repellence of the unit cell (2a) nearest to the entrance of circulating-water-flow wayssuch as a cooling plateis set up lower than other unit cells (2). In the fuel cell of an external humidification systeman oilthe liquid of an organic systemetc. can be used as a cooling medium again in addition to water.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a side view showing the solid polyelectrolyte type fuel cell module concerning this invention.

[Drawing 2]It is a front view in the state where the unit cell was decomposed.

[Drawing 3]It is an exploded perspective view of a cell unit and an insulation sheet.

[Drawing 4]It is a perspective view showing an opposed face with the oxidizing agent pole of conductive plates.

[Drawing 5]It is a perspective view showing an opposed face with the fuel electrode of conductive plates.
[Drawing 6]It is a front view showing an opposed face with the oxidizing agent pole of conductive plates.
[Drawing 7]It is a front view showing an opposed face with the fuel electrode of conductive plates.
[Drawing 8]It is a front view of a current collection plate.
[Drawing 9]It is a graph showing the temperature distribution of two or more cells which constitute a fuel cell module.
[Drawing 10]It is a graph showing the fall of the module voltages in working example 1 and the comparative example 1 with the passage of time.
[Drawing 11]It is a graph showing the fall of the module voltages in working example 1a-dand the comparative example 1 with the passage of time.
[Drawing 12]It is a graph showing the fall of the module voltages in working example e-i and the comparative example 1 with the passage of time.
[Drawing 13]It is a perspective view showing the appearance of the conventional solid polyelectrolyte type fuel cell module.
[Drawing 14]It is a sectional view showing the important section of the unit cell which constitutes this solid polyelectrolyte type fuel cell module.
[Drawing 15]It is an exploded perspective view of this unit cell.
[Drawing 16]It is a figure explaining the power generation principle of a solid polyelectrolyte type fuel cell.
[Explanations of letters or numerals]
(1) Fuel cell module
(2) Unit cell
(21) Cell unit
(22) Solid polyelectrolyte membrane
(23) Oxidizing agent pole
(24) Fuel electrode
(25) Insulation sheet

(3) Conductive plates

(34) Supply side breakthrough

(35) Discharge side breakthrough

(63) Fuel gas supply pipe

(64) Unconverted-gas exhaust pipe